International Journal of Zoology
and Research (IJZR)
ISSN(P): 2278-8816; ISSN(E): 2278-8824
Vol. 4, Issue 3, Jun 2014, 71-78

VARIABILITY OF GROUND BEETLES (COLEOPTERA-CARABIDAE) ASSEMBLAGES IN ATLAS CEDAR OF ALGERIA

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ABSTRACT

Preliminary results of studies on ground beetles communities inhabiting in Atlas cedar forest of Algeria are reported. The beetls were sampled in two habitat of cedar plantation of National park of Chréa (Blida) and the National park of Djurdjura (Bouira). A total of 266 individuals adult carabids belonging to 18 species were captured using pitfall trapping from January to December 2011. Cedar plantation of Djurdjura were richer in species (13) compared to cedar plantation of Chréa (11). All species found can be considered as valuable predators. In the first habitat, the most abundant species were *Calathus fuscipes algerinus* (50.64%), *Harpalus attenuatus* (23%), *Zabrus jurjurae* (10.25%) while in the second habitat; the most frequent species were *Calathus fuscipse algerinus* (43.6%), *Calathus circumseptus* (20%) and *Nebria andalusia* (10.9%). The family of Pterostichidae is richest with 11 species. The value of Shannon-Weaver shows that the cedar plantation of Djurdjura is more structured. The values of equitability confirm a balance in both habitats.

KEYWORDS: Carabids, Chréa, Djurdjura, Algeria, Forests

INTRODUCTION

The Atlas cedar is probably the most iconic landscape of North African tree species. In Algeria, the cedar forests are of special interest is directed towards the preservation and extension. They are located in protected areas and offer a wide variety of biotope of great biological wealth. Several researchers have reported that some Algerian cedar forests are in a delicate unbalance caused by several factors such as desertification, grazing, illegal logging, fires, severe climatic conditions and tick some defoliators (processionaire pine) which weakens the forest of cedar advantage and facilitates installation other secondary pests (Abdessemed,1981). These unbalance forests of cedar can be measured using insects as biological indicators. Ground beetles are widely used as indicators for measuring ecological impact because the family is rich in species, taxonomically well known, they are abundant in arable crops and seem highly sensitive to habitat changes(Lovei & Sunderland 1996, Rainio& Niemela 2003). This group represents a major element of the ground fauna (Dajoz, 2000). Variability in time and space is a natural attribute of animal population (Hanski & Gilpin 1991, den Boer & Reddingius 1996). The carabid species share space and time in forest sites, and their dispersion depends on climatic factors (Baguette, 1992a). They are the most abundant beetle families, with about 33000 Known species (Lorenz, 2005). They dominate in temperate regions and / or wet, and they become scarce when the climate becomes warmer and drier (Dajoz, 2002). Grounds beetles are considered excellent bio-indicators in both forested areas and cultivated circles. And each medium has a particular community of beetles, which defines the main features (Allegro, 1998). In Algeria the studies of ground beetles fauna in forest are still fragmentary; this is why we have undertaken our study in the cedar plantation of the National park of Chréa and the National park of Djurdjura. The aims of the present study was to see whether the composition of ground beetles communities and the abundance of the most abundant carabids species vary

among different cedar plantation in shorten-term (one year).We examined the differences in composition and diversity of ground beetles communities in different habitats.

MATERIAL AND METHODS

Study Area

The study was conducted in two habitats of cedar forests which are located in the National Park of Chréa (PNC) and the National Park of Djurdjura (PND), whose characteristics are summarized in Table 1.

The PNC is located fifty kilometer southwest of the capital Algiers, and extends over an area of 26.587ha. It lies between longitude 3°20 and 2°40 E and latitude 36°30 and 36° north.

The PND is located in north-central of Algeria, it is 140 Km southeast of Algiers and 50 Km from the Mediterranean sea. It is located between latitude 36° 25 `42`` and 36° 32` 02`` North and longitude 35° 7 `23`` and 04° 19` 43`` East.

Sampling Method

Ground beetles were sampled monthly using pitfall trapping from January to December 2011. Ten pitfall traps were placed in transects 8m apart in the selected periodically emptied. Mehenni (1994) said that pitfall traps are used extensively worldwide. Ten traps are appropriate to producing significant results (Obrtel, 1971). The traps consist of plastic contains of cylindrical form; diameter 10 cm, height 12 cm. Each pot was filled with acetic acid diluted at 30 % to kill and preserve samples. Traps were inserted into the ground and adjusted at the ground surface that they capture ground-dwelling traps insects easily without providing an obstacle. Damaged or disturbed traps were noted and excluded from the analysis .At the end of each month , the contents of each trap were removed, cleared of insects and placed backs in their holes. Carabids fauna were then identified to species using keys in Bedel (1895), Jeannel (1941) and Antoine (1955-1961). In order to validate our determination, a confirmation has been made by the team of Entomology, Department of Zoology, Murcia (Spain). Data on ecological preference of species were obtained from literature: Bedel (1985); Antoine (1955-1961); Casale and Sturani (1982) and Dajoz (2002).

Statistical Analysis

For a qualitative (presence /absence) comparison between the two species assemblages, the Sorensen index was calculated:

$$Cs = (2 * j) / (a + b)$$

Where, j = number of the species which are present in both areas, (*a*, *b*) = number of species in area (*a*) and number of species in area (*b*).

For comparing the species/abundance distributions in the two different communities the Shannon index was used:

$$H' = -\sum qi \log_2 qi$$ *Where qi= number of individuals per species.*

RESULTS AND DISCUSSIONS

Altogether 266 individuals, representing 18 species were captured during one year. 156 individuals were caught in the cedar plantation of Djurdjura and 110 individuals were captured in the cedar plantation of Chréa. The number of

individuals was higher in the cedar plantation of Djurdjura than in the cedar plantation of Chréa (Table 2). If we compare the species composition of the two habitats, small difference is found. In the cedar plantation of Djurdjura, we collected 13 species and 11 species in the cedar plantation of Chréa; 2 species shared by the two sites. This is explained by the fact that these two stations are located at high altitude where climatic conditions become more severe for some species. According Mehenni (1994), the higher of altitude is great, the average wealth is better. However beyond a limit value, the altitude of the action becomes negative, due to wind and snow. He mentioned that in the cedar forest Belezma (Algeria), the average wealth of Carabids is equal to 3.83. It should be noted that this area is located at 1834 m. By cons in a cedar forest of Cap Babor located at 1900 m altitude, species richness of this group of insects decreases to 2.83. The captured species belong to 5 families and 9 Tribes. The family Pterostichidae is the best represented with 11 species (Table 3). In the National Park of Mount Babor (Algeria), Benkhlil and Doumandji (1992) caught 28 species of carabids belonging to 7 families with a predominance of Pterostichidae. MEHENNI (1994) identified a total of 83 species of carabids in the cedar forests of Belzma, the Aures, Mount Babor, at Djurdjuran and Chréa. In a forest in Belgium, Baguette (1987) collected 56 species of carabids distributed among 8 families.

The group that dominates is Pterostichidae. Moreover, Baguette (1992a) noted the presence of 102 species divided among 9 families in the alluvial forests in Belgium with 41 species belonging to the family of Pterostichidae. In the mountains of Swan Lake Charlevoix in Quebec, Pena (2001) noted the presence of 36 species of ground beetles distributed among 5 families with the predominance of Pterostichidae. In this study the Pterostichidae also show that they have a vast potential for adaptation in different forest habitat selected. The most abundant ground beetles in the cedar plantation of Djurdjura were *Calathus fuscipes algericus* (50.64%), *Harpalus attenuatus* (23%) and *Zabrus jurjurae* (10.25%) (Figure 1), whereas in the cedar plantation of Chréa, the most frequent species were *Calathus fuscipes algericus* (43.6%), *Calathus circumseptus* (20%) and *Nebria andalusia* (10.9%) (Figure 2). Carabids in forest plantations include a number of species with a tendency to gregarism with diurnal activity (Baguette, 1992b). Some were located in only one site while others were distributed between the two sites. Various genera were distributed according to the altitudinal gradient in relation with vegetation and the fauna of the area. On the community scale, the criterion of habitat selection corresponds to biotic factors, whose combinations make it possible to describe how the species share space.

The biotic communities of carabids which occur in the cedar plantation of Djurdjura and the cedar plantation of Chréa depend up on the structure of vegetation and environmtal conditions. In general, entomological richness is a major factor in the environment choice of some species (Chakali & al, 2005). The absence of a rare species in the samples does not mean its real absence (Mehenni, 1994). The diversity index of Shannon-Weaver (H ') knows a maximum value in the cedar forests of Djurdjura (2.46 bits); while in the cedar forests of Chréa is 2.18 bits (Table 4). This implies that the cedar forest Djurdjura is the most favorable environment and has the best structured biodiversity. According MEHENNI (1994), diversity is low in the first stages of their evolution in an ecosystem. Values equal distribution confirms a balance of the environment in both stations surveyed.

Several environmental factors affect the distribution of forest Carabids (moisture level, nature of substrates, structure of the surface layer of soil, plant organization stratum at ground level, richness and composition of available prey, range of micro-habitats available for carrying out the various phases of the life cycle, etc ...). These factors are related and indirectly affected by the altitude. This sensitivity Carabids multiple factors structuring their environment, implies a strong differentiation of populations residing in the specific characteristics of different environments inhabited. On the whole, the

species assemblage of cedar plantation of Djurdjura presents an average affinity with the cedar plantation of Chréa (0, 50); the average Sorensen index probably reflects the sum of anthropogenic factors and differences in soil texture and humidity.

CONCLUSIONS

A variety of 18 carabid species with a predominance of Pterostichidae was identified. The results for the richness showed a great variability from one medium to another. It is even higher in the cedar forests of Djurdjura. The richness and abundance of these species in a given site depends on a complex set of environmental factors. In general, the distribution of carabid species identified occurs in relation to the altitudinal distribution of vegetation and arthropodologic medium composition. The species composition of different communities showed species with a preferendum for a station or a particular environment, highlighting an important bio-indicator species number. Carabid fauna of forest is characteristic and sharing species with neighboring fields and carabid species are rather specific to a particular environment (DERRON and Goy, 1996). In the National Parks of Djurdjura and Chréa the procession of ground beetles undergoes migration from one site to another in relation to environmental conditions. These protected areas are major sites for the development of the carabid fauna and deserve protection. The more effort must be made to get more information about the spatio-temporal distribution of carabid species in all ecosystems of the country to help to identify and locate endemic species, rare or endangered species for conservation.

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APPENDICES

Table 1: Characteristics of the Studied Area

Parameters / Area	Forest	Altitude (M)	Exposition	Zones
PNC (Blida)	Atlas cedar (*Cedrus atlantica*)	1450	Nord-est	Sub-humid
PND (Bouira)	Atlas cedar (*Cedrus atlantica*)	1300	Nord	Sub-humid

Table 2: List of Species Found in Cedar Plantation of Djurdjura and Cedar Plantation of Chréa

Habitat / Species	Cedar Plantation of Djurdjura	Cedar Plantation of Chréa
Agonum nigrum Dejean 1828	1	0
Brachinus sclopeta (Fabricius, 1792).	0	3
Calathus circumseptus (Germar, 1842)	1	22
Calathus fuscipes algerinus (Goeze, 1777)	79	48
Calathus opacus (Lucas, 1846)	4	3
Calathus sp	3	1
Eurycarabus famini algerinus Dejean, 1826	0	3
Harpalus attenuatus Stephens 1828	36	0
Harpalus sp	0	1
Laemostenus barbarus (Lucas, 1846)	1	0
Laemostenus complanatus (Dejean, 1828).	0	8
Macrothorax morbillosus (Fabricius, 1792).	4	8
Nebria andalusia (Rambur, 1837).	5	12
*Parophonus hespericus (*Jeanne, 1985)	3	0
Sphodrus leucophtalmus (Linné, 1758)	0	1
Zabrus farctus Zemmenmann, 1831	1	0
Zabrus jurjurae Peyerimhoff ,1908	16	0
Zabrus sp.	2	0
Number of individuals	156	110
Species richness	13	11
Total number of individuals	**266**	

Table 3: Taxonomic Position of Carabid Species Collected in the Studied Area

Groupes	Families	Tribes	Species
Simplicia	Carbidae	Carabini	*Macrothorax morbillosus* Fabricus, 1792 *Eurycarabus famini algerinus* Dejean, 1826
	Nibriidae	Nibriini	*Nebria andalusia* Rambur, 1837
Conchyfera	Pterostichidae	Platynini	*Calathus circumseptus* (Germar, 1842) *Calathus fuscipes algerinus (*Goeze, 1777) *Calathus opacus (Lucas, 1846) Calathus sp.*
		Sphodrini	*Sphodrus leucophtalmus* (Linné, 1758) *Laemostenus complanatus* (Dejean, 1828) *Leamostenus barbarus* (Lucas ,1846)
		Zabrini	*Zabrus farctus* Zemmenmann, 1831 *Zabrus jurjurae* Peyerimhoff, 1908 *Zabrus sp.*
		Anchomenini	Agonum nigrum Dejean, 1828
	Harpalidae	Harpalini	*Harpalus attenuatus* Stephens 1828 *Harpalus sp.*
		Trichotichnini	*Parophonus hespericus (*Jeanne, 1985)
Balteifera	Brachinidae	Brachinini	*Brachinus sclopeta* (Fabricius, 1792)

Table 4: Species Richness, Shannon Index, Equitability and Sorensen Index of Ground Beetles Communities in the Studied Area

Habitat Parameters	Cedar Plantation Of Djurdjura	Cedar Plantation Of Chréa
Species richness	13	11
H' (Shannon index)	2,46	2,18
H max (bits)	3,70	3,46
Equitability	0,66	0,63
Sorensen index	0,5	

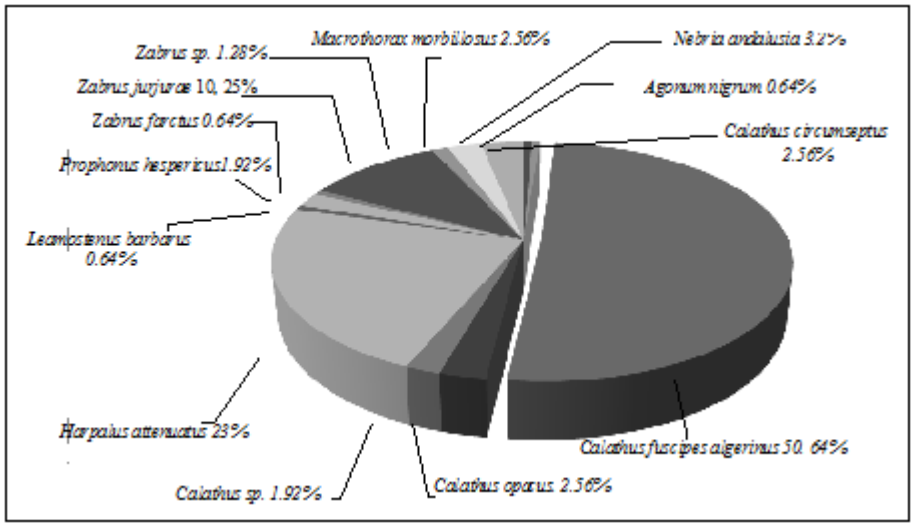

Figure 1: Relatives Abundances of *Carabid species* Captured in the Cedar Plantation of Djurdjura

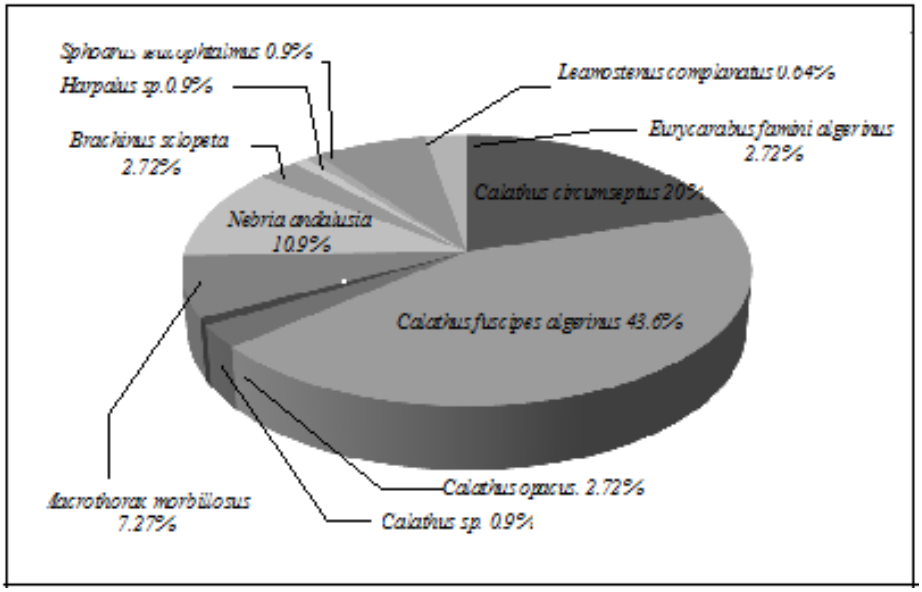

Figure 2: Relatives Abundances of *Carabid species* Captured in the Cedar Plantation of Chréa